Trauma Rounds

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Management of Urologic Injuries

JOHN SNEAD, MD:* The patient for presentation today is a 6-year-old boy who was run over by a large bus. He sustained severe crushing injuries to the lower abdomen and pelvic region. The initial evaluation at San Francisco General Hospital showed a blood pressure of 60/20 mm of mercury with poor peripheral perfusion. The abdomen rapidly became distended. The pelvis was grossly unstabile and there was penile bleeding. Attempts to pass a Foley catheter were unsuccessful. Rectal examination revealed a flaccid sphincter and a free-floating prostate. After resuscitation with 1,000 ml of Ringer's lactate an intravenous pyelogram was obtained which showed a normal kidney on the right side. The upper pole of the left kidney was poorly visualized and the lower pole was not seen.

On immediate laparatomy, extensive injuries were found. These included a ruptured left hemidiaphragm, ruptured spleen and a hugh retroperitoneal hematoma extending from the pelvis to both diaphragms. The bladder was separated from the urogenital diaphragm by a distance of over four inches. Operative treatment consisted of repair of the diaphragm and removal of the spleen and left kidney. The pelvic hematoma was not entered. The bladder injury was treated by suprapubic cystostomy and suprapubic drains, which was accomplished without entering the retroperitoneal hematoma.

During operation there was cardiovascular instability and 11 units of whole blood were administered. Postoperatively, all of the wounds continued to bleed and results of coagulation tests showed a prothrombin time of 17 seconds, and a partial thromboplastin time of greater than 100 seconds. Fresh, warm blood was obtained through a special program with Irwin Memorial Blood Bank. After administration of this blood and eight platelet packs, the oozing ceased. Two more units of whole blood were administered slowly over the next 24 hours. The pelvic fractures which included acetabular displacement were treated by skeletal traction with a tibial pin.

The postoperative course was stormy and marked by respiratory failure, mild renal failure and mild elevation of serum bilirubin. This reached a peak at six days after injury. Since that time the patient has progressively improved and is doing well at this time two weeks after injury.

DONALD D. TRUNKEY, MD:† *We have asked Dr. Oscar Salvatierra to discuss this patient and give his approaches to treating urologic trauma.*

OSCAR SALVATIERRA, MD:‡ This patient provides an example of what I also found in my Vietnam and civilian experience. A large percentage of

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urological injuries are associated with other abdominal and chest injuries. These other major organ system injuries are usually the more obvious and usually assume a higher priority for treatment. This is an essential point, as it emphasizes that treatment of the urological injury must be correlated with the management of the associated problems.

In a severely injured patient, such as the one presented here, a short time invested in intravenous pyelography, will provide essential information about the contralateral kidney if nothing else. In this case the primary renal injury involved the left kidney and I understand there was extensive fragmentation and hemorrhage from the renal substance. Nephrectomy was the proper treatment, especially in the context of the other injuries and since the right kidney was normal. Attempts at repair of the left kidney would have only resulted in the risk of additional hemorrhage, intraoperatively and postoperatively, and prolongation of the operating time.

The same principles hold true in the management of the severed membranous urethra and associated massive pelvic hemorrhage in this patient. The treatment of choice in this case was suprapubic cystostomy without any attempt at urethral approximation. Violation of the large contained retroperitoneal hematoma would have risked extensive hemorrhage from the injured pelvic veins. I shall make additional comments relative to the urethral injury later in the presentation.

A good dictum in the treatment of renal injuries is that nonoperative treatment should be chosen whenever possible. However, conservative management requires proper radiographic assessment of urinary tract anatomy. Intravenous pyelography, especially infusion nephrotomography, can best be accomplished after the treatment of shock. At this point definitive radiographic investigation should be initiated if there is a possibility of renal injury, unless prohibited by the need for urgent surgical intervention for associated life-threatening injuries. In many instances, x-ray studies of the abdomen will be required in a badly injured patient, and it is relatively easy to give the patient contrast material before these films. Any information which is obtained may be of value, if only to provide information that the opposite, uninjured kidney is functional.

If the intravenous pyelogram (IVP) shows diminution in renal contrast excretion or minimal delay in the appearance of contrast material, as opposed to that of the opposite kidney, contusion is implied. At the other end of the spectrum, nonfunction indicates either severe renal fragmentation or renal pedicle injury and demands either urgent arteriographic assessment, or exploration as dictated by the patient's clinical situation. One instance in which intravenous pyelograms may be normal but still associated with major renal injury is in certain types of penetrating wounds to the kidney in which there may be an arteriovenous fistula. If persistent hematuria is present, early arteriography in addition to pyelography should be considered to rule out some type of major vascular injury.

My principal indication for exploring renal injuries is the presence of an expanding flank mass or an expanding or pulsatile perirenal hematoma noted at laparotomy. In addition, if there is clinical evidence of continuous hemorrhage after transfusion of three units of whole blood, surgical exploration should be strongly considered. Other indications for exploration relate to the extent of injury as noted on x-ray examination. Severe fragmentation of the kidney with loss of the renal architecture, a renal pedicle injury or a ureteral injury, are indications for surgical treatment.

More patients with penetrating renal injuries will require exploration than patients with renal injury secondary to blunt trauma. Approximately 85 percent of nonpenetrating renal injuries are simple contusions or superficial lacerations. All of these patients should be treated conservatively. About 5 percent of blunt renal injuries are of such severity that operative intervention is indicated for control of life-threatening hemorrhage. Then there is a group of about 10 percent with moderately severe renal injuries that require careful observation. A conservative treatment plan is continued as long as the flank mass remains stable, the patient does not manifest continuing volume loss clinically, and hematuria is transient or mild.

F. WILLIAM BLAISDELL, MD:* *Dr. Salvatierra, how significant do you think urinary extravasation is to the hazard of subsequent infection? Many argue for routinely exploring the kidney when there is any evidence of injury. The basis of this is that secondary complications, such as infection with or without secondary hemorrhage, will be a greater threat to the patient than the exploration itself.*

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DR. SALVATIERRA: I do not routinely explore and drain all urinary extravasations and do not believe that the risk of infection is very great. Urinary extravasation secondary to penetrating trauma carries with it the possibility of ureteral injury and all ureteral injuries demand early exploration and repair. In blunt trauma, mild to moderate extravasation confined within Gerota's fascia may be initially managed conservatively, particularly if ureteral decompression is satisfactory. However, voluminous extravasation of sterile urine, or minimal infected extravasation, can result in septic complications initially, or subsequently may lead to retroperitoneal cicatrization and ureteral obstruction.

DR. BLAISDELL: *You would be guided by the* IVP?

DR. SALVATIERRA: Yes, primarily by the extent of the extravasation and whether or not it is confined by Gerota's fascia.

A PHYSICIAN: *I would like to ask a question about long term complications. When you treat renal injuries conservatively, do problems such as renal hypertension or chronic renal failure develop later?*

DR. SALVATIERRA: Renal failure is essentially nonexistent following renal injury. The only time this possibility is apt to occur would be in a major injury to a solitary kidney, or in rare cases of bilateral severe injury. Although the incidence of hypertension following renal injury is very low, it does occur and long term follow-up of the patient is necessary. Hypertension can be the result of ischemia in a damaged renal segment, renal artery stenosis, or possibly the constricting enveloping effect from a cicatrizing subcapsular hematoma, the so-called "Page" kidney.

A PHYSICIAN: *What is your policy regarding retroperitoneal hematoma if you have not obtained a pyelogram before laparotomy?*

DR. SALVATIERRA: I use the same criteria for exploration of this hematoma as if I had a pyelogram. In other words, I would adopt a conservative approach if the hematoma was stable, nonexpanding, nonpulsatile and appeared to be contained. However, if exploration is deemed necessary, it is imperative to have information about the status of the opposite kidney. Here the advantages of a preoperative pyelogram become evident. The reason, of course, is that if the surgeon opens the fascia enclosing the kidney, severe hemorrhage may ensue from an untreatable venous hilar injury which may require nephrectomy.

DR. TRUNKEY: I would underscore that policy, which is the one we had adopted at this hospital. I would like to point out, however, that any central hematoma which is associated with the duodenum or pancreas is explored routinely. Dr. Salvatierra is talking about the lateral or flank hematoma. The only difficulty we encounter is always being able to tell which organ the hematoma is associated with, as flank hematomas may merge with central hematomas.

DR. SALVATIERRA: An additional point I would like to make is that not all patients with urological injuries will present with obvious hematuria. Hematuria may be absent in parenchymal renal trauma, renal pedicle injuries and ureteral injuries. In any patient with blunt or penetrating injury to the chest, abdomen or back, a high index of suspicion for possible urological injury should exist.

This leads me to ureteral injuries, which of all urological injuries are the most apt to be missed initially. Ureteral injuries are difficult to diagnose preoperatively unless an intravenous pyelogram has shown obvious urinary extravasation. Ureteral injury is unusual following blunt trauma but must be considered a possibility following penetrating trauma. A ureteral injury should be suspected whenever a missile track passes near the ureter. In such cases it is preferable to isolate and inspect the ureter at laparotomy. The injection of indigo carmine intravenously may be helpful intraoperatively if any doubt exists about ureteral injury and will help localize the site of injury.

Certain principles of repair are especially important in the management of ureteral injuries. Bullet injuries of the ureter result in large ragged defects, with considerable surrounding tissue damage. Because the ureter will not heal properly if necrotic tissue is interposed, the injured area should be completely resected (even in partially transected ureters). Each free end of ureter should then be spatulated so that an elliptical end-to-end anastomosis can be accomplished. Concentric constriction of the anastomosis is thus avoided. It is also important that tension be avoided at the suture line, and that the ureteral blood supply be preserved by not stripping ureteral

adventitia. I prefer to use stents only for alignment and position of the ureter in those patients with a badly traumatized retroperitoneal space. In most instances, the use of a foreign body in the ureter such as a T tube or ureteral catheter only increases the risk of anastamotic leak.

Almost all bullet injuries of the ureter may be handled in this manner, except those adjacent to the ureterovesical junction, where a ureteroneocystostomy can often best be done. In rare instances where ureteral loss is extensive, consideration can be given to ureteroureterostomy using an anastamosis to the contralateral ureter or—even more rarely—to autotransplantation of the kidney. Decisions such as these will be based on the condition of the patient and the associated injuries.

A PHYSICIAN: *Dr. Salvatierra, what do you do with the missed ureteral injury?*

DR. SALVATIERRA: The principal signs of delayed recognition of a ureteral injury include: urinary fistula through the surgical wound, drain site or bullet wound; massive urinary acites; abscess, and stricture associated with urinary extravasation. It is thus understandable why late recognition of a ureteral injury carries with it a greater than 40 percent incidence of secondary nephrectomy. When there is delayed recognition of the injury, there is usually extensive tissue induration or infection in the area where primary ureteral anastomosis might be accomplished. In these cases, it is important to establish good urinary drainage above the area of injury, such as with a nephrostomy, and not attempt to reestablish ureteral continuity until a later date.

Complete disruption of the posterior urethra is a serious injury and its management has evoked much controversy. The method of treatment employed in this case is that advocated by Johanson and MacKinnon. In this approach urethral continuity is established by delayed elective urethroplasty after initial simple cystostomy. Delayed elective urethroplasty can later be carried out with ease and with the presence of remarkably little scar tissue. The striking feature of simple cystostomy followed by delayed elective urethroplasty is that the incidence of stricture, incontinence and impotence appears to be much lower than that following conventional treatment which establishes uretheral continuity immediately after injury. The latter method should probably not be employed if it requires opening a large contained retroperitoneal pelvic hematoma. This consideration is of paramount importance in the presence of severe associated injuries such as in the case presented today.

If the surgeon who explores the severed membranous urethra is experienced in handling this type of lesion, if the pelvic hematoma is not large and if the urethral injury is the principal problem, direct approximation of the severed urethra can be carried out. When I have followed this approach, I have used Vest perineal sutures for the approximation. Direct suture approximation of the urethra is difficult and attempts at this type of procedure only result in additional tissue damage with subsequent increased scar tissue in the area. Traction on the Foley balloon catheter

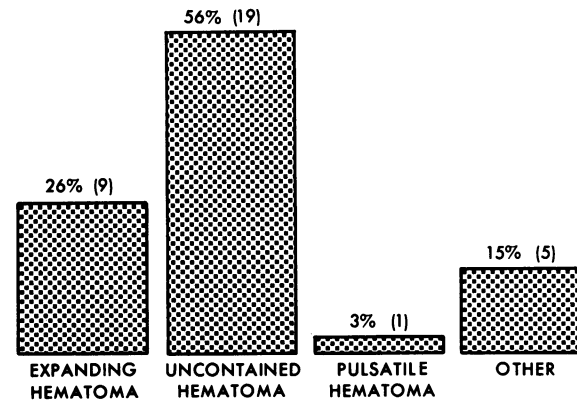

Chart 1.—Reasons for opening Gerota's fascia in 34 patients.

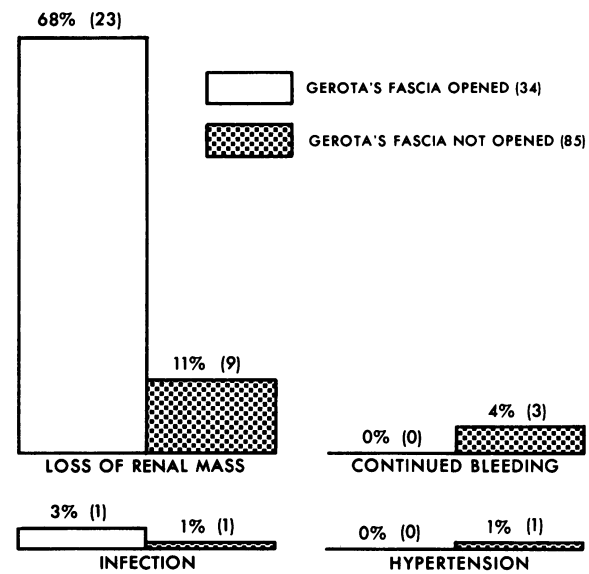

Chart 2.—Postoperative complications in 119 cases of renal trauma.

should not be employed as this may damage the bladder neck and cause postoperative incontinence.

If it appears that the membranous urethra injury is an incomplete rupture, rather than complete membranous-prostatic urethral dismemberment, then simple cystostomy alone should be done. Several weeks after partial disruption, managed in this fashion, the cystostomy tube can be clamped. If normal micturition is demonstrable through an intact nonstricture urethra with a voiding urethrogram no further treatment is required.

DR. TRUNKEY: We are in complete agreement on the management of urologic trauma as you have reviewed it. Drs. Holcroft, Lim and myself recently reviewed the cases of renal injury treated at this hospital during the last 10 years. In 140 of these cases, there was definite definition of renal damage. Confirming your earlier observation, 8 percent had no hematuria. Of the 140 patients, 34 (24 percent) had Gerota's fascia opened for the reasons you outlined, that is, a uncontained hematoma, expanding hematoma or pulsatile hematoma (Chart 1). There was a very high incidence of nephrectomy (56 percent) in those patients where Gerota's fascia was opened. In contrast 106 of the 140 cases were followed conservatively. In six of these patients exploration subsequently was done for either nephrectomy or partial nephrectomy. There was minimal postoperative morbidity in the rest of these patients managed conservatively. Data for 85 of these patients are shown in Chart 2. There was a single instance of hypertension in these patients.